REMARKS

Claims 1-93 were examined. Applicant has amended claims 1, 16, 17, 19, 25, 32, 39, 41, 43, 54, 66 and 82. Claims 13-15 were cancelled. No new matter has been presented.

Rejections under 35 USC §103:

The Examiner has rejected claims 1, 5, 8-11, 23, 31-36 under §102(a) as being anticipated by Delavaux (US 5,060,312).

The coherent lightwave detector disclosed in Delavaux's patent US 5,060,312 is not a quadrature modulated data receiver. Instead, it is an example of a coherent detector for optical communications, which is also disclosed in our patent's references such as J. Saulnier et al. "Optical polarization-diversity receiver integrated on Titanium-diffused Lithium Niobate", IEEE Photonics Technology Letters, v.3. #10, 1991; F. Ghirardi et al. "InP-based 10 Ghz Bandwidth Polarization diversity heterodine photodetector with electrooptical adjustability," IEEE Photonics Technology Letters, v.6. #7, 1994; D. Hoffman et al. "Integrated optics eight-port 90.degree. hybrid on LiNbO.sub.3" Journal of Lightwave technology, v.7. #5, 1989, pp.794-798.

The present invention discloses a receiver for quadrature modulation data, see paragraphs [0016], [0017], Fig. 1(b), Fig. 8 (a and b). Delavaux's invention has a completely different function in that it receives binary signals which require two polarizations, while the present invention receives quadrature modulation signals which require one polarization.

The solutions unveiled in these prior art references are far from practical implementation. They can hardly meet the requirements of telecom system in the beginning of 1990s. They are built for systems characterized by low traffic, short distances and small amounts of channels. In the present time a new generation of communication system requirements emerged placing specific constraints to the system elements that involve new technical solutions. The single monolithically integrated device proposed in the present invention can meet the requirements of the present communication systems.

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A single monolithically integrated device is shown in Fig. 2a of the present invention and described in detail in paragraphs [0048] and [0049]. In the single monolithically integrated device, the photodiodes are integrated with the device on the same chip. The photodiodes 102 are depicted in Fig. 2a and now inserted in amended Claim 1.

This makes the present invention different from Delavaux's patent US 5,060,312 which describes a free-space optical communications system without specifically addressing the use of photodetectors. The rigidity and robustness achieved through the monolithically integrated solution proposed in the present invention, are capable of meeting the more rigorous Telcordia standards that were adapted after Delavaux's invention of 1990.

The Examiner has rejected claims 2-4, 6, 7, 22, 24-30, 37 and 38 under §103(a) as obvious over Delavaux (US 5,060,312).

The present invention is different from Delavaux's invention in that it uses couplers which are adjustable. Adjustable couplers implemented in 90-degrees optical hybrid according to the present invention allow:

1) compensations for fabrication errors in each coupler/shifter independently (increasing fabrication yield);

2) an effective signal detection is achieved by balancing of the hybrid's couplers;

3) real-time compensation for vibration/temperature fluctuations, including the higher frequencies;

4) adaptive stabilization and compensation of various noise factors, which can be represented as the linear matrix transformation on the signal.

The latter does not represent new material, but is an inherent property of the device disclosed in the present invention that performs a linear transformation of the incoming signal, see paragraph [0099].

Amended Claim 1 includes first, second, third and fourth adaptive couplers, previously listed in Claims 13-15.

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Regarding claims 2-4: These advantageous features of the coherent receiver with adjustable couplers allow for its implementation in a number of different applications. These possible applications include free-space optical links, optical pointing devices or tracking devices.

Delavaux does not teach adjustable couplers in US 5,060, 312 and does not teach quadrature modulation format for data. Adjustable couplers are not only beneficial for the present device, but they are essential elements for the present device's functionality. Furthermore, the use of adjustable couplers extend the range of applications of the present invention.

The Examiner has rejected claims 12-21, 39, 40, 42, 53and 54 under §103(a) as obvious over Delavaux (US 5,060,312) in view of Shlaak (DE3442988 A1).

The ability to adjust couplers in the present invention provides new class of devices that allow for the enablement of quadrature modulated data detection systems being installed in modern high density communications WDM optical transmission systems, which are not anticipated by Delavaux's and Shlaak's inventions.

The Examiner has rejected claims 41 and 43-52 under §103(a) as obvious over Delavaux (US 5,060,312) in view of Shlaak (DE3442988 A1), further in view of Hurrell et al (US 2004/0160661).

Regarding claims 41 and 43-48: Hurrel's patent application, filed in 2003 (later than the present application), discloses fiber-based detection schematics for QPSK transmission schemes which are unacceptable in modern communication systems since they do not qualify under Telcordia standards. As a result, Hurrel's device cannot be used for free-space communications or sensing applications. Furthermore, Delavaux and Schlaak fail to consider QPSK transmission schemes.

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The Examiner has rejected claims 56-90 under §103(a) as obvious over Delavaux (US 5,060,312) in view of Yao (US5,654,818).

Regarding claims 56-90: Yao's patent US5654818 does not teach

1) integrated quadrature modulation device (Yao's patent addresses polarization independent devices, not quadrature modulation devices);

2) single planar chip device integration,

3) adjustable device components.

Monolithically integrated solution for QPSK modulation combined with an ability to adjust device's components provides a new function of the device that allows application in high density fiber optic and free-space communications systems.

The Examiner has rejected claims 91-93 under §103(a) as obvious over Delavaux (US 5,060,312) in view of Lee et al. (US 2004/0208414).

Regarding Claims 91-93: Delavaux does not teach quadrature modulation schemes for optical communication systems. QPSK modulation provides an essential increase of data throughput for optical links, which is a critical parameter for modern communication systems. Delavaux's patent does not address these modern communication systems.

The invention in Lee's patent teaches time division multiplexed (TDM) communications, which is quite different from QPSK wavelength division multiplexed communications. Furthermore, Lee's invention does not provide a solution for high density WDM communications with quadrature data modulation.

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In one embodiment of the present invention, a monolitically integrated optical device for receiving and demodulating a quadrature modulated optical signal having one polarization and transmitted via optical path, is presented. The device has two inputs comprising of one of the following orientations; a first adjustable coupler connected to the first input and producing at least a first and second output, a second adjustable coupler connected to the second input and producing at least a first and second output, a third adjustable coupler connected to the first output of the first coupler and to the first output of the second coupler, or a fourth adjustable coupler connected to the second output of the first coupler and to the second output of the second coupler. Each couple is individually tuned by electrodes. This tuning is based on a first and a second crossing waveguides with an angle selected to minimize crosstalk and losses between the first and second cross waveguides. The first crossing waveguide is connected to one of the first or second outputs from the first coupler with an input of the fourth coupler. The second crossing waveguide is connected to one of the first or second outputs from the second coupler with an input of the third coupler. The first phase shifter is coupled to the first and second waveguides. Finally, the first and second waveguides are connected to one of the outputs of the first or second coupler and one of the inputs of the third or fourth couplers. Photodiodes convert the optical signal into an electrical signal, wherein the first, second, third and fourth couplers, the two crossing waveguides, the phase shifter and photodiodes are all built on a single planar chip made of an electro-optical material.

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CONCLUSION

Applicant believes that the application is now in condition for allowance. The Commissioner is authorized to charge Deposit Account 08-1641 for any payment due in connection with this paper, including petition fees and extension of time fees.

Respectfully submitted,
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